WHAT IS CLAIMED IS:

1. A radio frequency (RF) down-convertor with reduced local oscillator leakage, for demodulating an input signal *x(t)*, comprising:

a synthesizer for generating mixing signals φ_1 and φ_2 which vary irregularly over time, where $\varphi_1 * \varphi_2$ has significant power at the frequency of a local oscillator signal being emulated, and neither φ_1 nor φ_2 has significant power at the frequency of said local oscillator signal being emulated;

a first mixer coupled to said synthesizer for mixing said input signal *x(t)* with said mixing signal φ_1 to generate an output signal $x(t)\ \varphi_1$; and

a second mixer coupled to said synthesizer and to the output of said first mixer for mixing said signal $x(t)\ \varphi_1$ with said mixing signal φ_2 to generate an output signal $x(t)\ \varphi_1\ \varphi_2$.

a1

2. The radio frequency (RF) down-convertor of claim 1 wherein said synthesizer further comprises:

a synthesizer for generating mixing signals φ_1 and φ_2, where $\varphi_1 * \varphi_1 * \varphi_2$ does not have a significant amount of power within the bandwidth of said input signal *x(t)* at baseband.

3. The radio frequency (RF) down-convertor of claim 2, further comprising:

a DC offset correction circuit.

4. The radio frequency (RF) down-convertor of claim 3, wherein said DC offset correction circuit comprises:

a DC source having a DC output; and

a summer for adding said DC output to an output of one of said mixers.

5. The radio frequency (RF) down-convertor of claim 2, further comprising:

a closed loop error correction circuit.

6. The radio frequency (RF) down-convertor of claim 5, wherein said closed loop error correction circuit further comprises:

an error level measurement circuit and

a time-varying signal modification circuit for modifying a parameter of one of said mixing signals φ_1 and φ_2 to minimize said error level.

7. The radio frequency (RF) down-convertor of claim 6, wherein said error level measurement circuit comprises a power measurement.

8. The radio frequency (RF) down-convertor of claim 6, wherein said error level measurement circuit comprises a voltage measurement.

9. The radio frequency (RF) down-convertor of claim 6, wherein said error level measurement circuit comprises a current measurement.

10. The radio frequency (RF) down-convertor of claim 6, wherein said modified parameter is the phase delay of one of said mixing signals φ_1 and φ_2.

a2

11. The radio frequency (RF) down-convertor of claim 6, wherein said modified parameter is the fall or rise time of one of said mixing signals φ_1 and φ_2.

12. The radio frequency (RF) down-convertor of claim 6, wherein said modified parameter includes both the phase delay and the fall or rise time of one of said mixing signals φ_1 and φ_2.

13. The radio frequency (RF) down-convertor of claim 2 wherein said synthesizer further comprises:

a synthesizer for generating mixing signals φ_1 and φ_2, where said mixing signals φ_1 and φ_2 can change with time in order to reduce errors.

14. The radio frequency (RF) down-convertor of claim 1, further comprising:

a filter for removing unwanted signal components from said *x(t)* φ_1 signal.

15. The radio frequency (RF) down-convertor of claim 1, wherein said mixing signals φ_1 and φ_2 are random.

a3

16. The radio frequency (RF) down-convertor of claim 1, wherein said mixing signals φ_1 and φ_2 are pseudo-random.

17. The radio frequency (RF) down-convertor of claim 1, wherein said mixing signals φ_1 and φ_2 are irregular.

18. The radio frequency (RF) down-convertor of claim 1, wherein said mixing signals φ_1 and φ_2 are digital waveforms.

a3 cont

19. The radio frequency (RF) down-convertor of claim 1, wherein said mixing signals φ_1 and φ_2 are square waveforms.

20. The radio frequency (RF) down-convertor of claim 1, further comprising:
a local oscillator coupled to said synthesizer for providing a signal having a frequency that is an integral multiple of the desired mixing frequency.

21. A method of demodulating a radio frequency (RF) signal $x(t)$ with reduced local oscillator leakage comprising the steps of:

a4

generating mixing signals φ_1 and φ_2 which vary irregularly over time, where φ_1 and *φ_2 has significant power at the frequency of a local oscillator signal being emulated, and neither φ_1 nor φ_2 has significant power at the frequency of said local oscillator signal being emulated;

mixing said input signal $x(t)$ with said mixing signal φ_1 to generate an output signal $x(t)\ \varphi_1$; and

mixing said signal $x(t)\ \varphi_1$ with said mixing signal φ_2 to generate an output signal $x(t)\ \varphi_1\ \varphi_2$.

22. An integrated circuit comprising the radio frequency (RF) down-converter of claim 1.

25. The radio frequency (RF) down-converter of claim 1, where said synthesizer uses different patterns to generate signals φ_1 and φ_2.

a5

26. The radio frequency (RF) down-converter of claim 1, wherein said synthesizer uses a single time base to generate both mixing signals φ_1 and φ_2.

WHAT IS CLAIMED IS:

1. A radio frequency (RF) down-convertor with reduced local oscillator leakage, for demodulating an input signal $x(t)$, comprising:

a synthesizer for generating mixing signals φ_1 and φ_2 which vary irregularly over time, where $\varphi_1 * \varphi_2$ has significant power at the frequency of a local oscillator signal being emulated, and neither φ_1 nor φ_2 has significant power at the frequency of said local oscillator signal being emulated;

a first mixer coupled to said synthesizer for mixing said input signal $x(t)$ with said mixing signal φ_1 to generate an output signal $x(t)\ \varphi_1$; and

Sub a1 a second mixer coupled to said synthesizer and to the output of said first mixer for mixing said signal $x(t)\ \varphi_1$ with said mixing signal φ_2 to generate an output signal $x(t)\ \varphi_1\ \varphi_2$.

2. The radio frequency (RF) down-convertor of claim 1 wherein said synthesizer further comprises:

a synthesizer for generating mixing signals φ_1 and φ_2, where $\varphi_1 * \varphi_1 * \varphi_2$ does not have a significant amount of power within the bandwidth of said input signal $x(t)$ at baseband.

3. The radio frequency (RF) down-convertor of claim 2, further comprising:

a DC offset correction circuit.

4. The radio frequency (RF) down-convertor of claim 3, wherein said DC offset correction circuit comprises:

a DC source having a DC output; and

a summer for adding said DC output to an output of one of said mixers.

5. The radio frequency (RF) down-convertor of claim 2, further comprising:

a closed loop error correction circuit.

6. The radio frequency (RF) down-convertor of claim 5, wherein said closed loop error correction circuit further comprises:

an error level measurement circuit and

a time-varying signal modification circuit for modifying a parameter of one of said mixing signals φ_1 and φ_2 to minimize said error level.

7. The radio frequency (RF) down-convertor of claim 6, wherein said error level measurement circuit comprises a power measurement.

8. The radio frequency (RF) down-convertor of claim 6, wherein said error level measurement circuit comprises a voltage measurement.

9. The radio frequency (RF) down-convertor of claim 6, wherein said error level measurement circuit comprises a current measurement.

10. The radio frequency (RF) down-convertor of claim 6, wherein said modified parameter is the phase delay of one of said mixing signals φ_1 and φ_2.

sub a2

11. The radio frequency (RF) down-convertor of claim 6, wherein said modified parameter is the fall or rise time of one of said mixing signals φ_1 and φ_2.

12. The radio frequency (RF) down-convertor of claim 6, wherein said modified parameter includes both the phase delay and the fall or rise time of one of said mixing signals φ_1 and φ_2.

13. The radio frequency (RF) down-convertor of claim 2 wherein said synthesizer further comprises:
a synthesizer for generating mixing signals φ_1 and φ_2, where said mixing signals φ_1 and φ_2 can change with time in order to reduce errors.

14. The radio frequency (RF) down-convertor of claim 1, further comprising:
a filter for removing unwanted signal components from said *x(t)* φ_1 signal.

15. The radio frequency (RF) down-convertor of claim 1, wherein said mixing signals φ_1 and φ_2 are random.

sub a3

16. The radio frequency (RF) down-convertor of claim 1, wherein said mixing signals φ_1 and φ_2 are pseudo-random.

17. The radio frequency (RF) down-convertor of claim 1, wherein said mixing signals φ_1 and φ_2 are irregular.

sub a3 cont

18. The radio frequency (RF) down-convertor of claim 1, wherein said mixing signals φ_1 and φ_2 are digital waveforms.

19. The radio frequency (RF) down-convertor of claim 1, wherein said mixing signals φ_1 and φ_2 are square waveforms.

20. The radio frequency (RF) down-convertor of claim 1, further comprising:
a local oscillator coupled to said synthesizer for providing a signal having a frequency that is an integral multiple of the desired mixing frequency.

sub a4

21. The radio frequency (RF) down-convertor of claim 1, wherein said synthesizer uses a single time base to generate both mixing signals φ_1 and φ_2.

22. The radio frequency (RF) down-convertor of claim 1, where said synthesizer uses different patterns to generate signals φ_1 and φ_2.

23. A method of demodulating a radio frequency (RF) signal *x(t)* with reduced local oscillator leakage comprising the steps of:
generating mixing signals φ_1 and φ_2 which vary irregularly over time, where $\varphi_1 * \varphi_2$ has significant power at the frequency of a local oscillator signal being emulated, and neither φ_1 nor φ_2 has significant power at the frequency of said local oscillator signal being emulated;
mixing said input signal *x(t)* with said mixing signal φ_1 to generate an output signal *x(t)* φ_1; and
mixing said signal *x(t)* φ_1 with said mixing signal φ_2 to generate an output signal *x(t)* $\varphi_1 \varphi_2$.

24. An integrated circuit comprising the radio frequency (RF) down-convertor of any one of claims 1 - 22.

sub a5

25. A computer readable memory medium, storing computer software ~~code in a~~ hardware development language ~~for fabrication~~ of an integrated circuit comprising ~~the radio~~ frequency (RF) down-convertor of any one of claims 1 - ~~22.~~

AMENDED SHEET

sub a5

26. ~~A computer data signal embodied in a carrier wave, said computer data signal comprising computer software code in a hardware development language for fabrication of an integrated circuit comprising the radio frequency (RF) down-convertor of any one of claims 1 - 22.~~